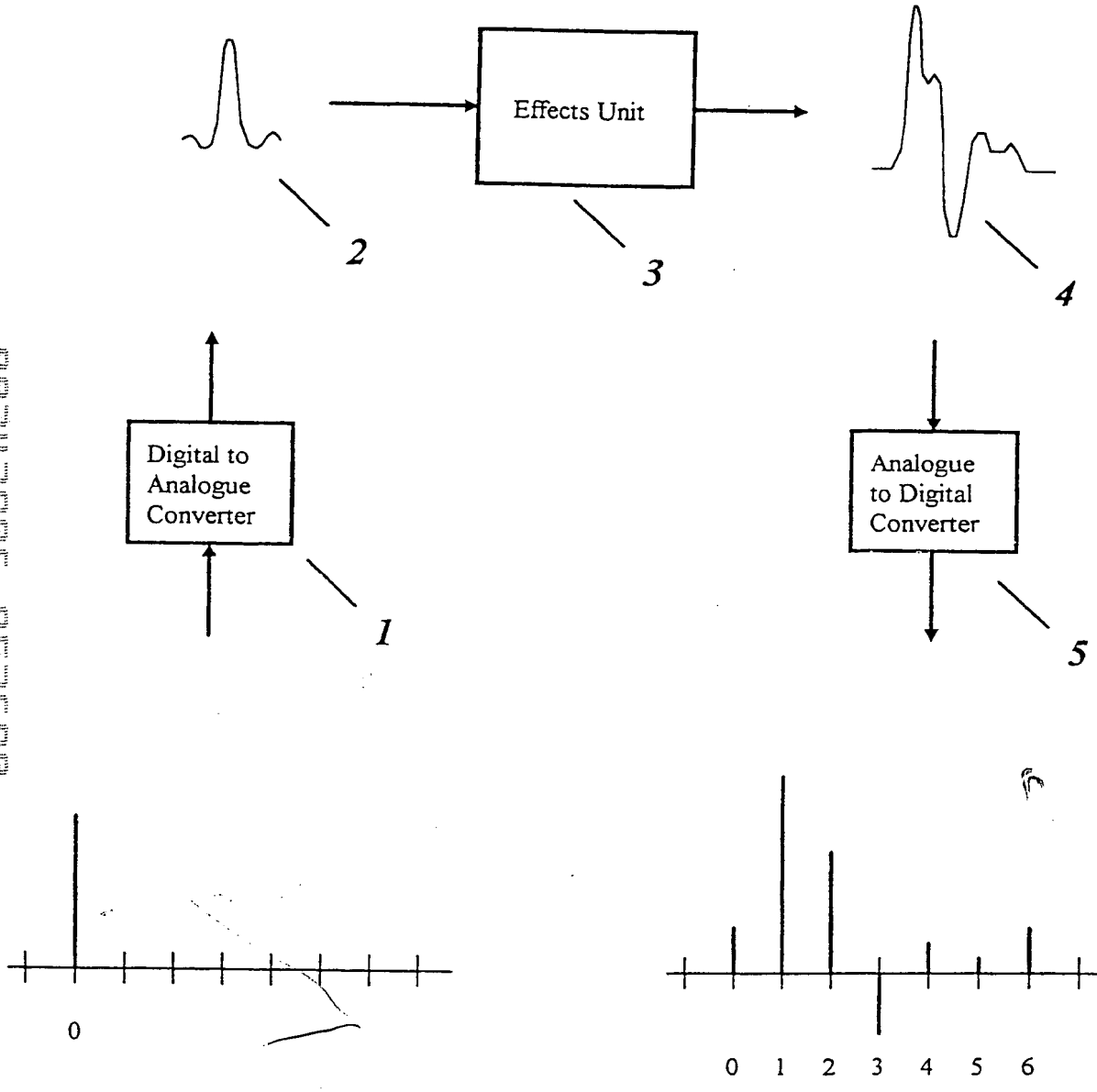

Effects Unit
2
3
4
Digital to Analogue Converter
1
Analogue to Digital Converter
5
0
0 1 2 3 4 5 6
Test Signal T
Response Signal R

Fig 1

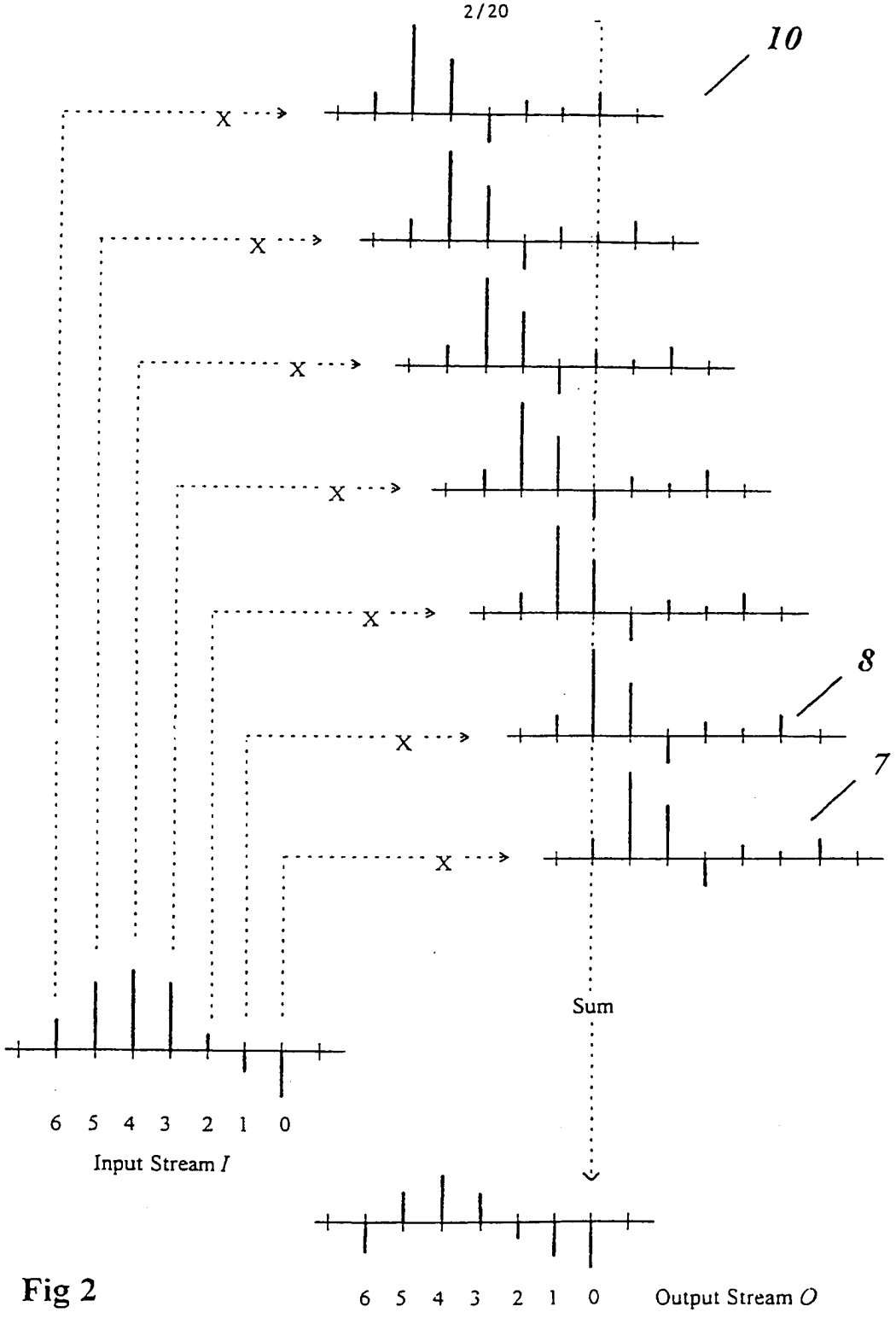


Fig 2

SUBSTITUTE SHEET (RULE 26)

Fig 3a

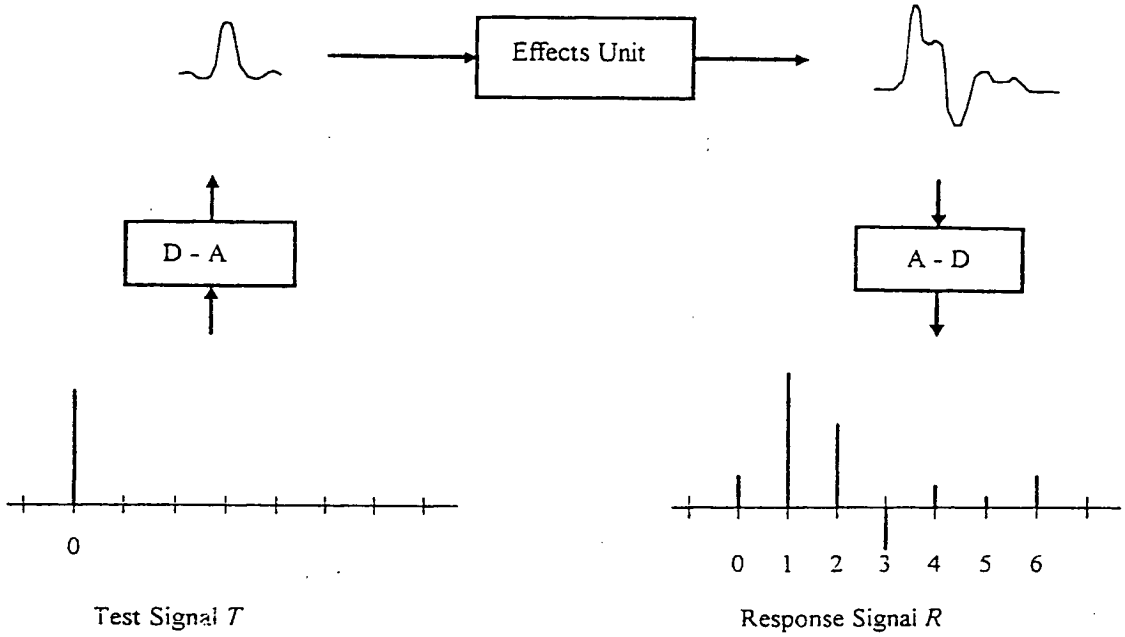
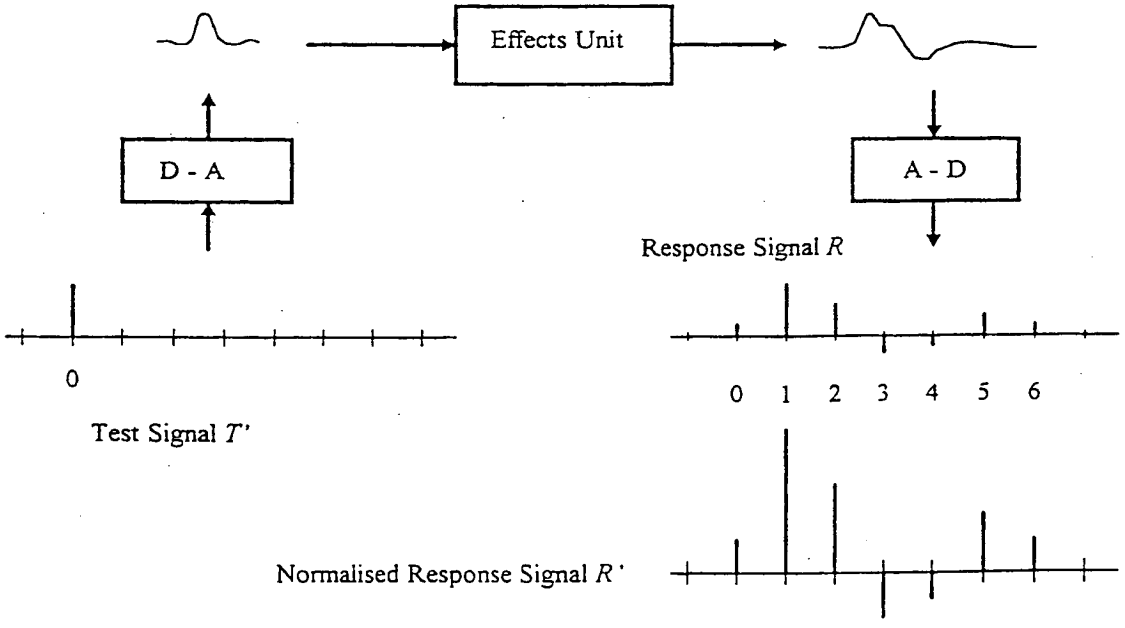

Effects Unit
D - A
A - D
0
0 1 2 3 4 5 6
Test Signal T
Response Signal R

Fig 3b


Effects Unit
D - A
A - D
Response Signal R
0
0 1 2 3 4 5 6
Test Signal T'
Normalised Response Signal R'

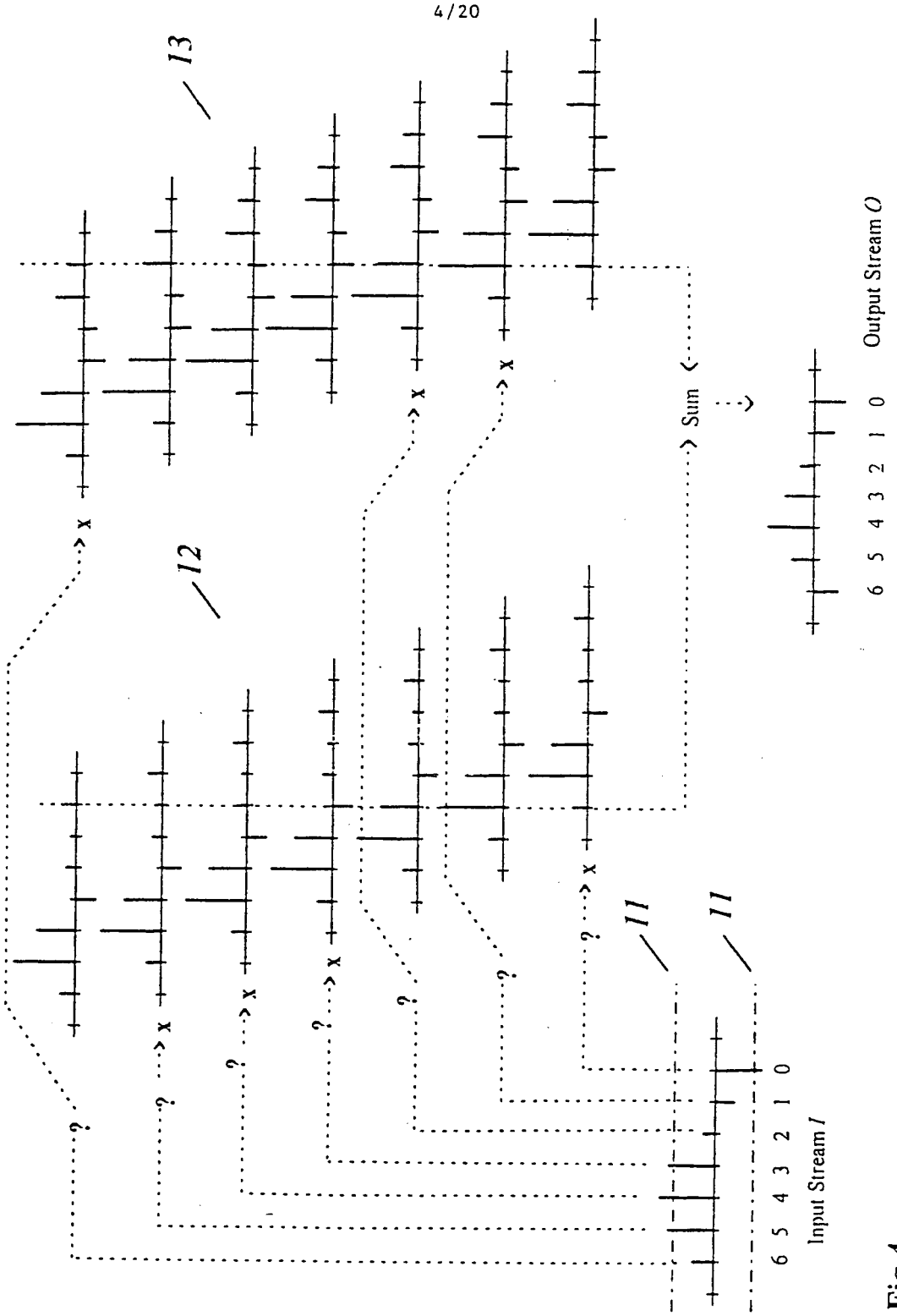

13
12
11
11
Sum
Output Stream O
6 5 4 3 2 1 0
Input Stream I
6 5 4 3 2 1 0

Fig 4

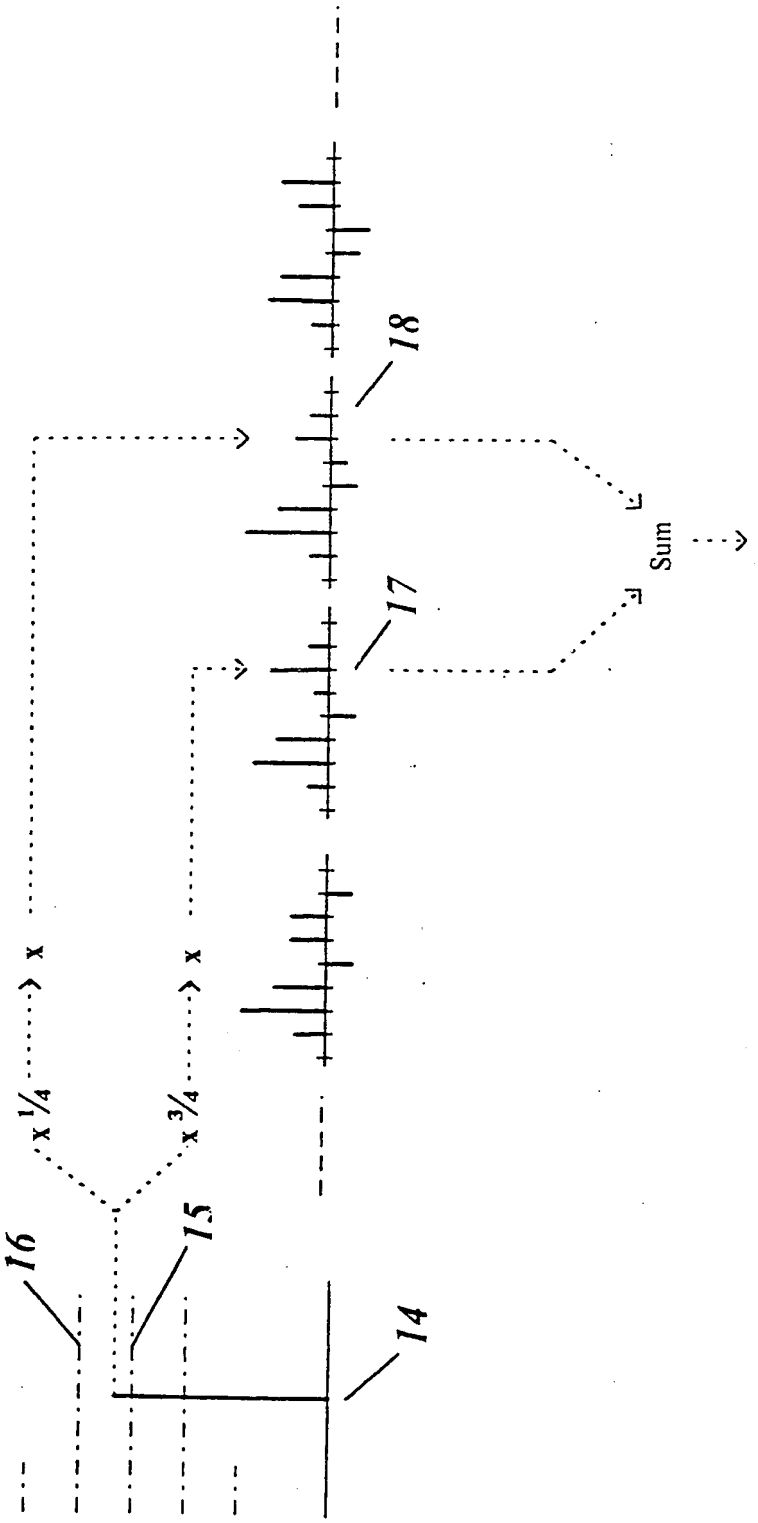


Fig 5

Fig 6

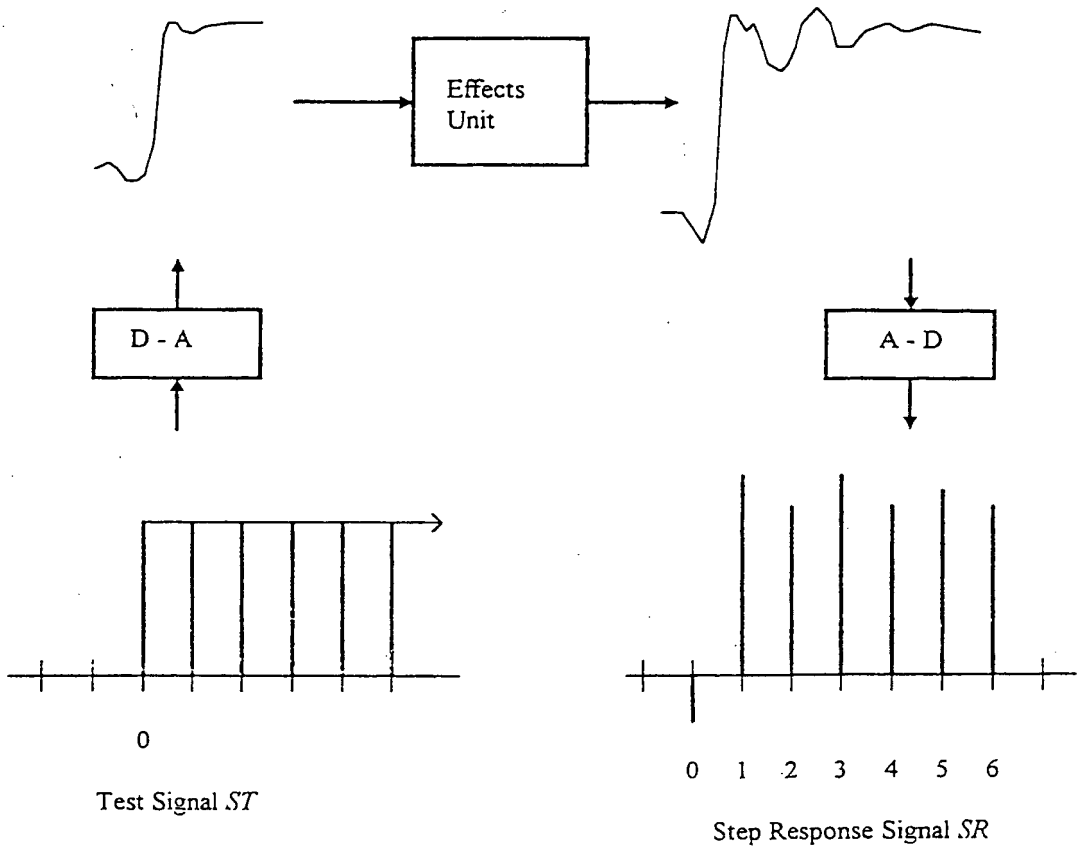
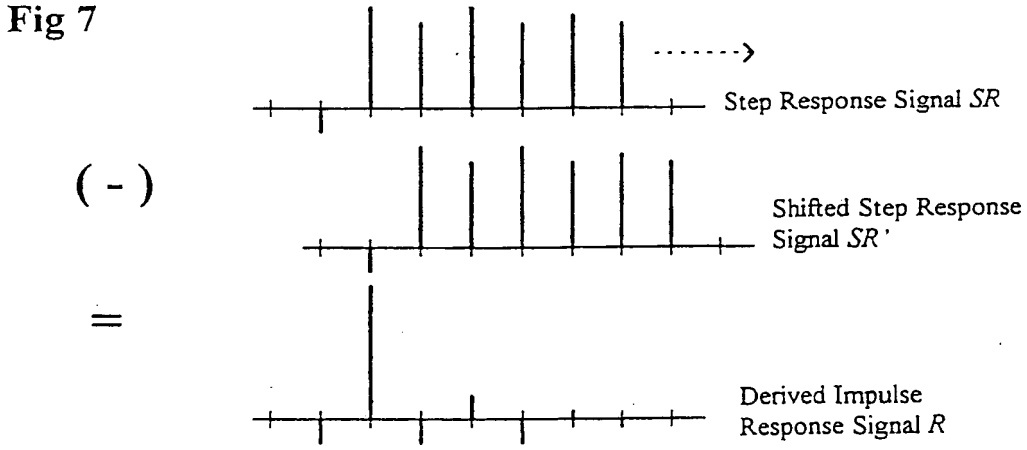

Effects Unit
D - A
A - D
0
Test Signal ST
0 1 2 3 4 5 6
Step Response Signal SR

Fig 7


Step Response Signal SR
(-)
Shifted Step Response Signal SR'
=
Derived Impulse Response Signal R

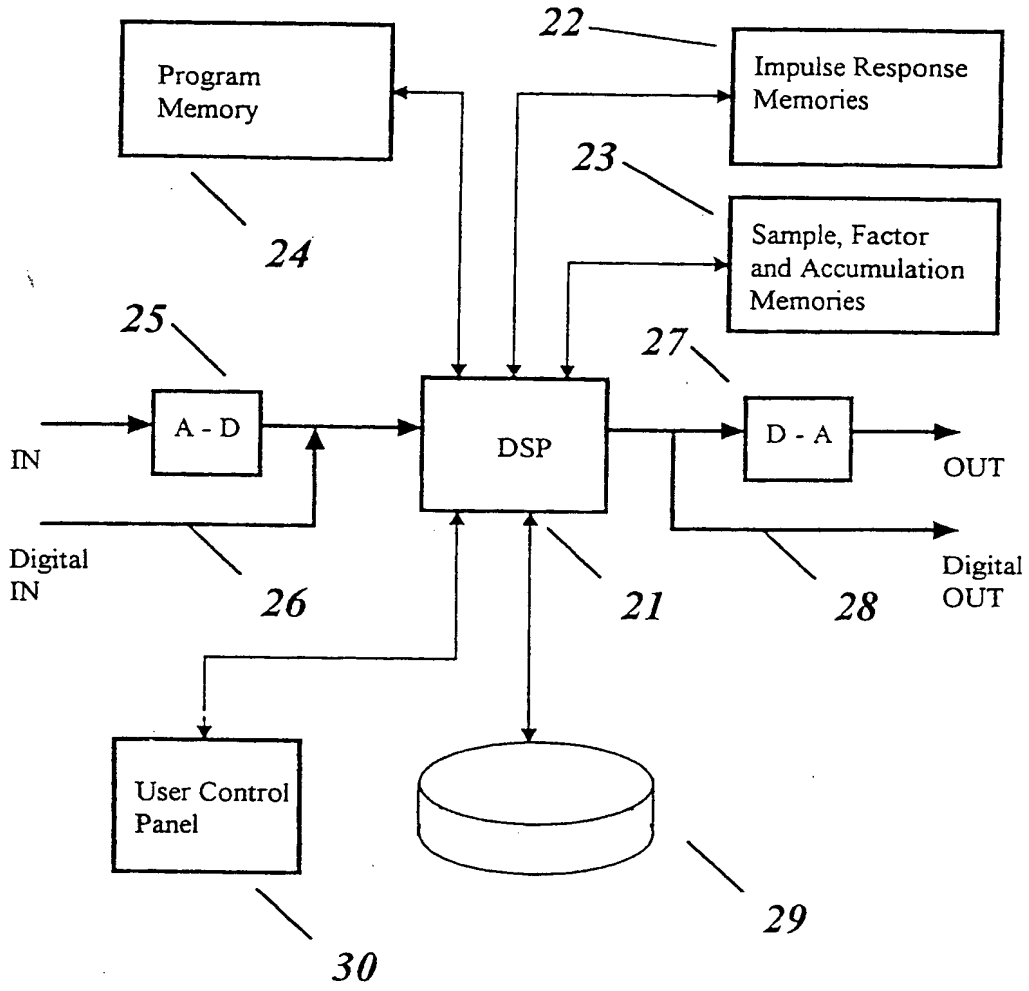

Program Memory
24
22
Impulse Response Memories
23
Sample, Factor and Accumulation Memories
25
27
A - D
DSP
D - A
IN
OUT
Digital IN
26
21
28
Digital OUT
User Control Panel
30
29

Fig 8

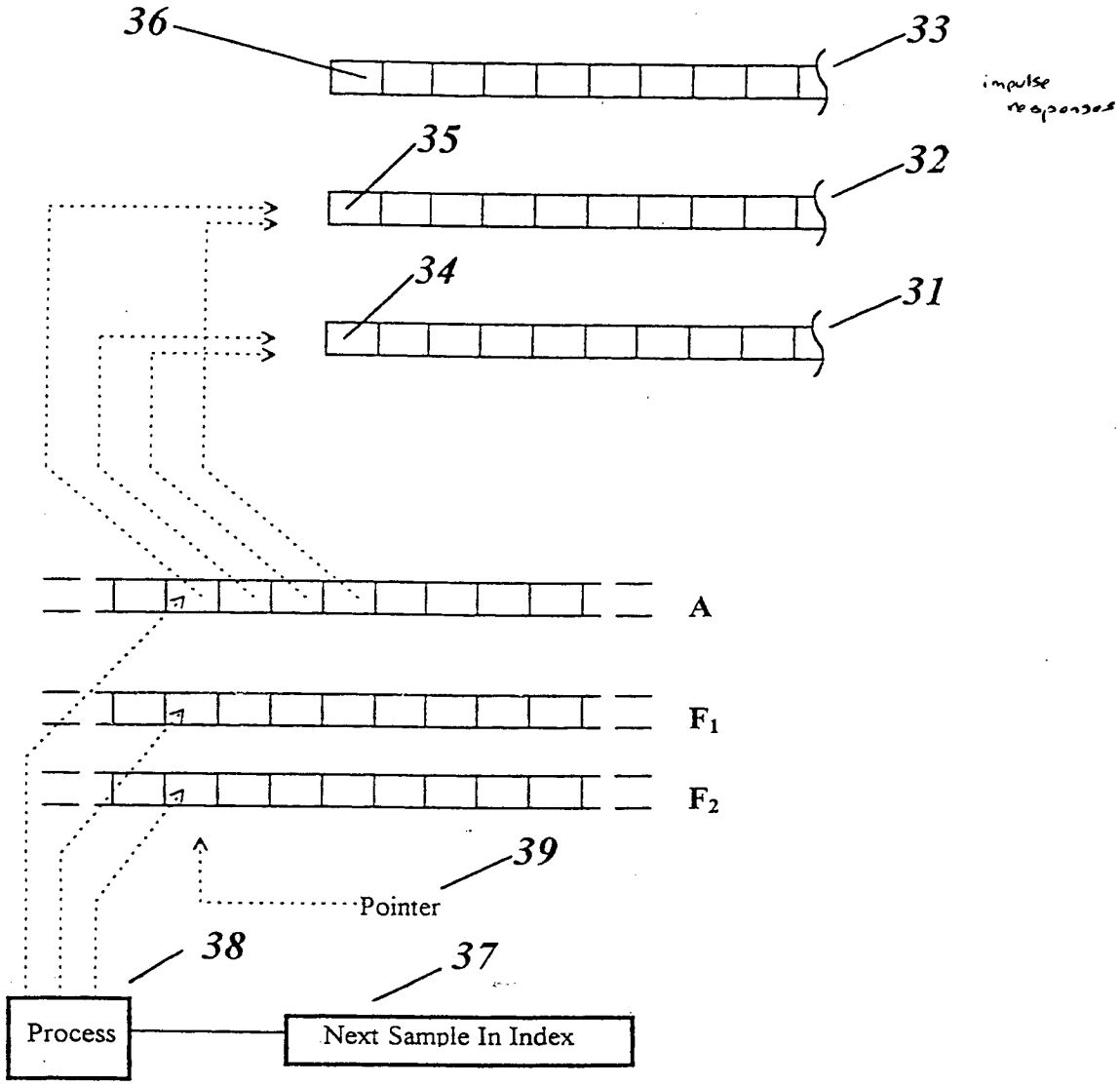

36
33
impulse responses
35
32
34
31
A
F1
F2
39
Pointer
38
37
Process
Next Sample In Index

Fig 9

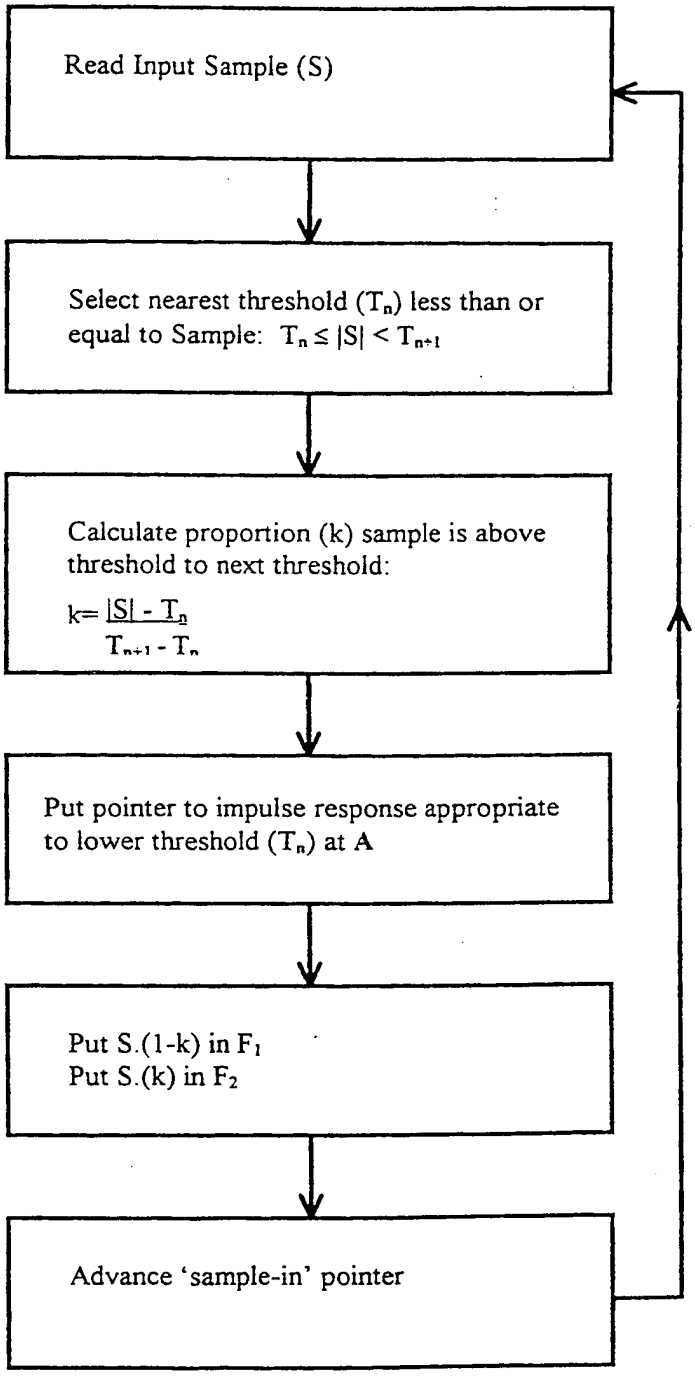
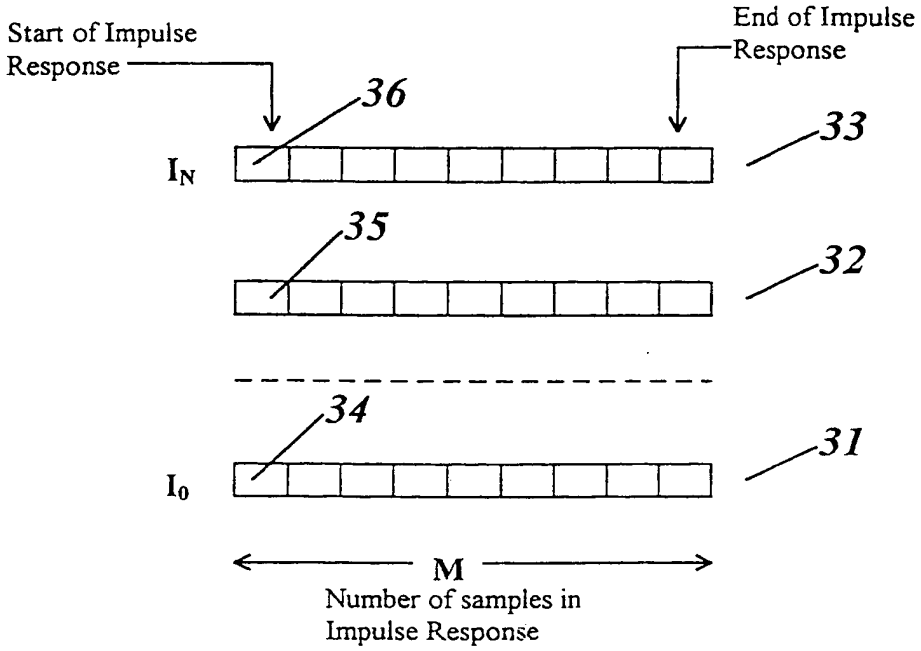

Read Input Sample (S)
Select nearest threshold (T_n) less than or equal to Sample: $T_n \leq |S| < T_{n+1}$
Calculate proportion (k) sample is above threshold to next threshold:
$k = \frac{|S| - T_n}{T_{n+1} - T_n}$
Put pointer to impulse response appropriate to lower threshold (T_n) at A
Put S.(1-k) in F_1
Put S.(k) in F_2
Advance 'sample-in' pointer

Fig 10


Start of Impulse Response
End of Impulse Response
36
33
I_N
35
32
34
31
I_0
M
Number of samples in Impulse Response

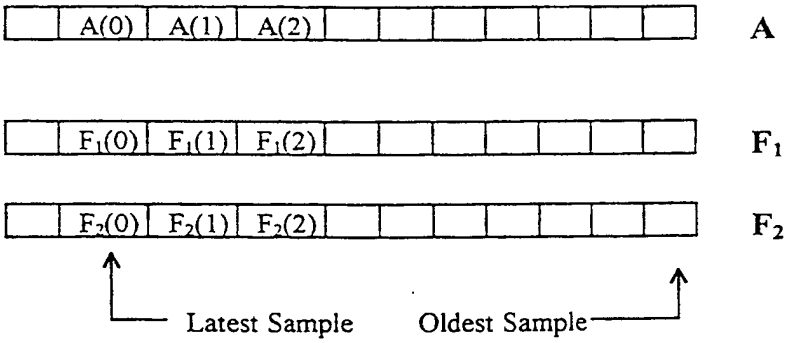

A(0) A(1) A(2)
A
$F_1(0)$ $F_1(1)$ $F_1(2)$
F_1
$F_2(0)$ $F_2(1)$ $F_2(2)$
F_2
Latest Sample
Oldest Sample

Fig 11

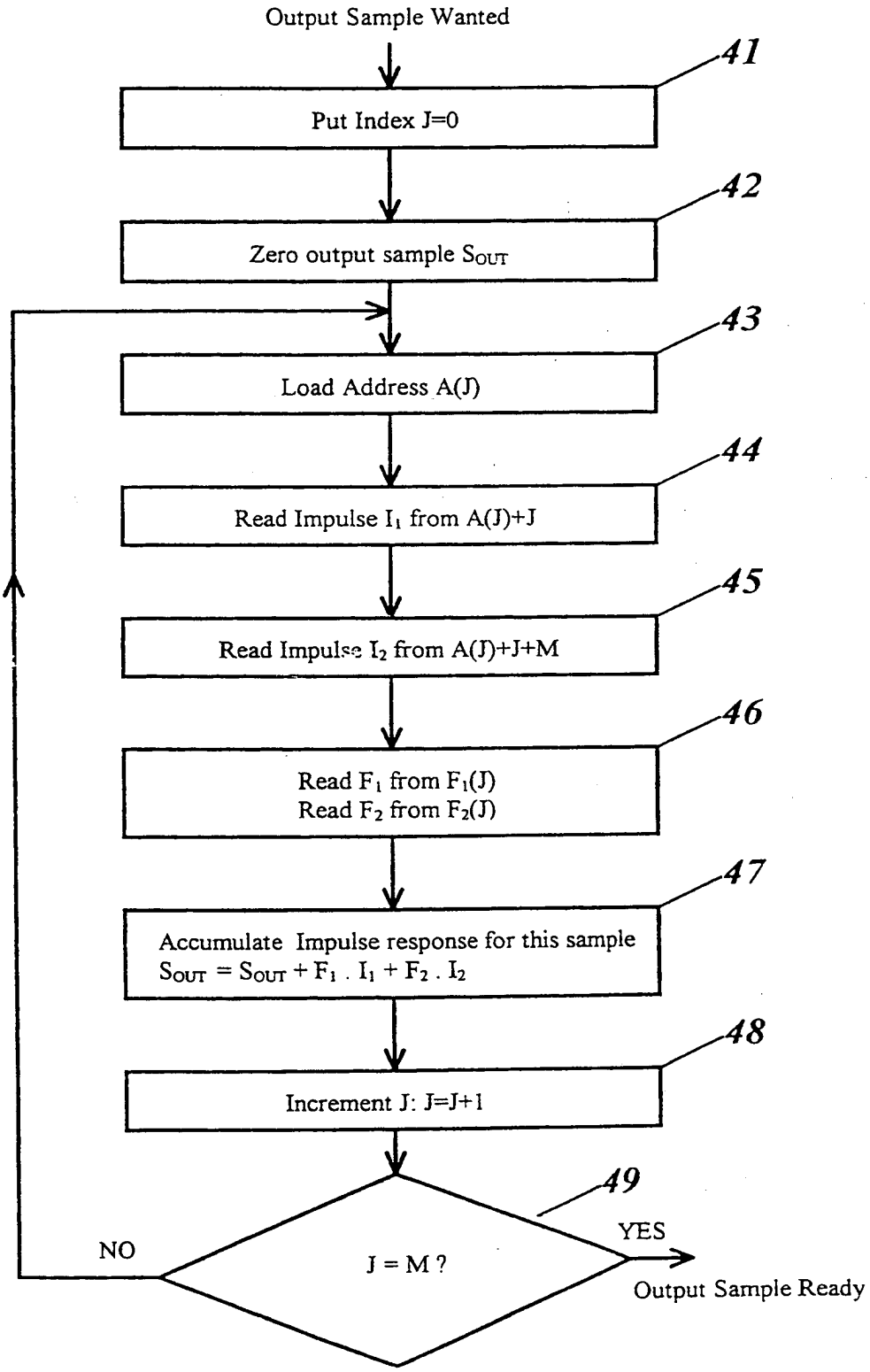

Output Sample Wanted
41
Put Index J=0
42
Zero output sample SOUT
43
Load Address A(J)
44
Read Impulse I1 from A(J)+J
45
Read Impulse I2 from A(J)+J+M
46
Read F1 from F1(J)
Read F2 from F2(J)
47
Accumulate Impulse response for this sample
SOUT = SOUT + F1 . I1 + F2 . I2
48
Increment J: J=J+1
49
J = M ?
NO
YES
Output Sample Ready

Fig 12

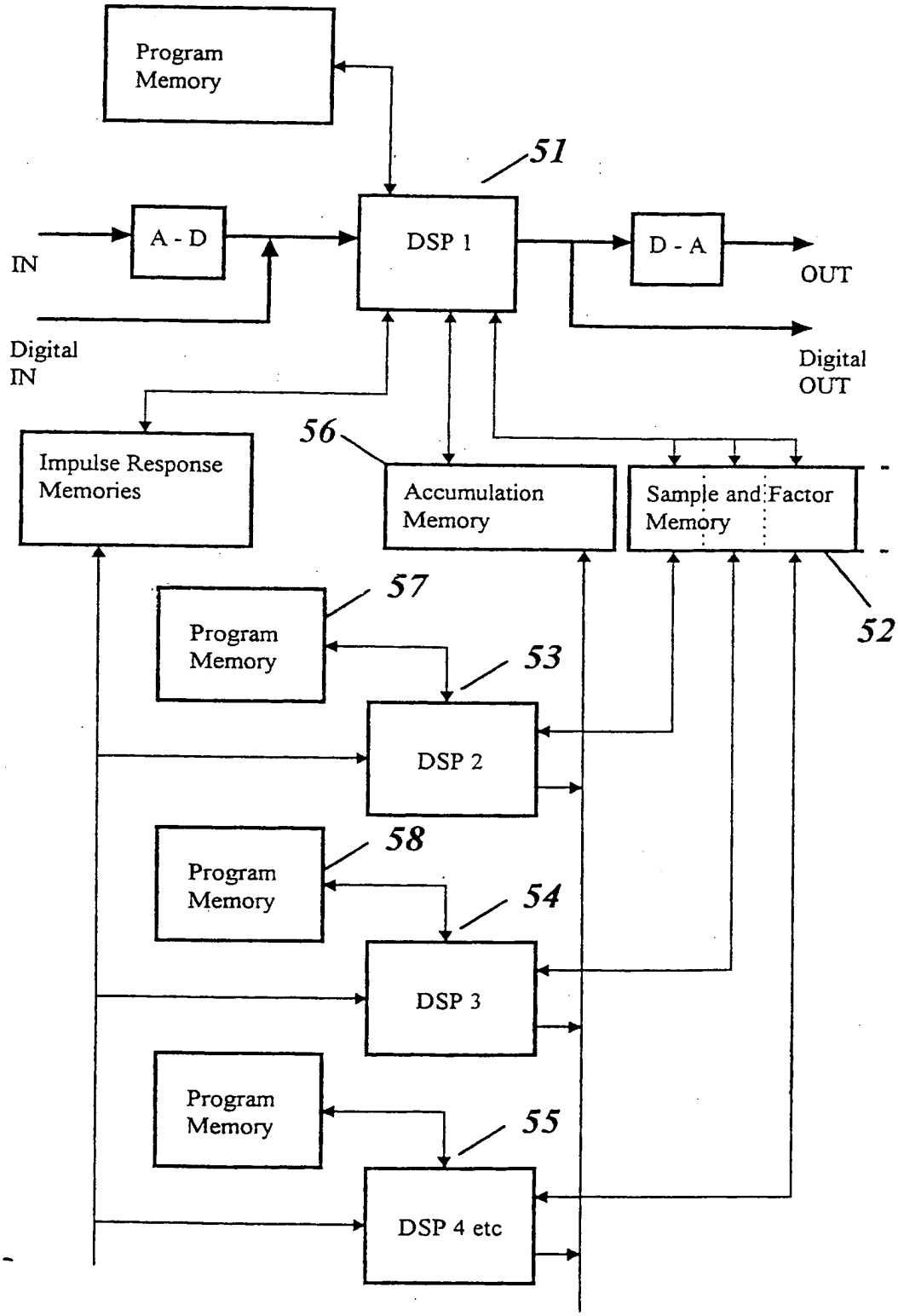

Program Memory
51
A - D
DSP 1
D - A
IN
OUT
Digital IN
Digital OUT
Impulse Response Memories
56
Accumulation Memory
Sample and Factor Memory
52
57
Program Memory
53
DSP 2
58
Program Memory
54
DSP 3
Program Memory
55
DSP 4 etc

Fig 13

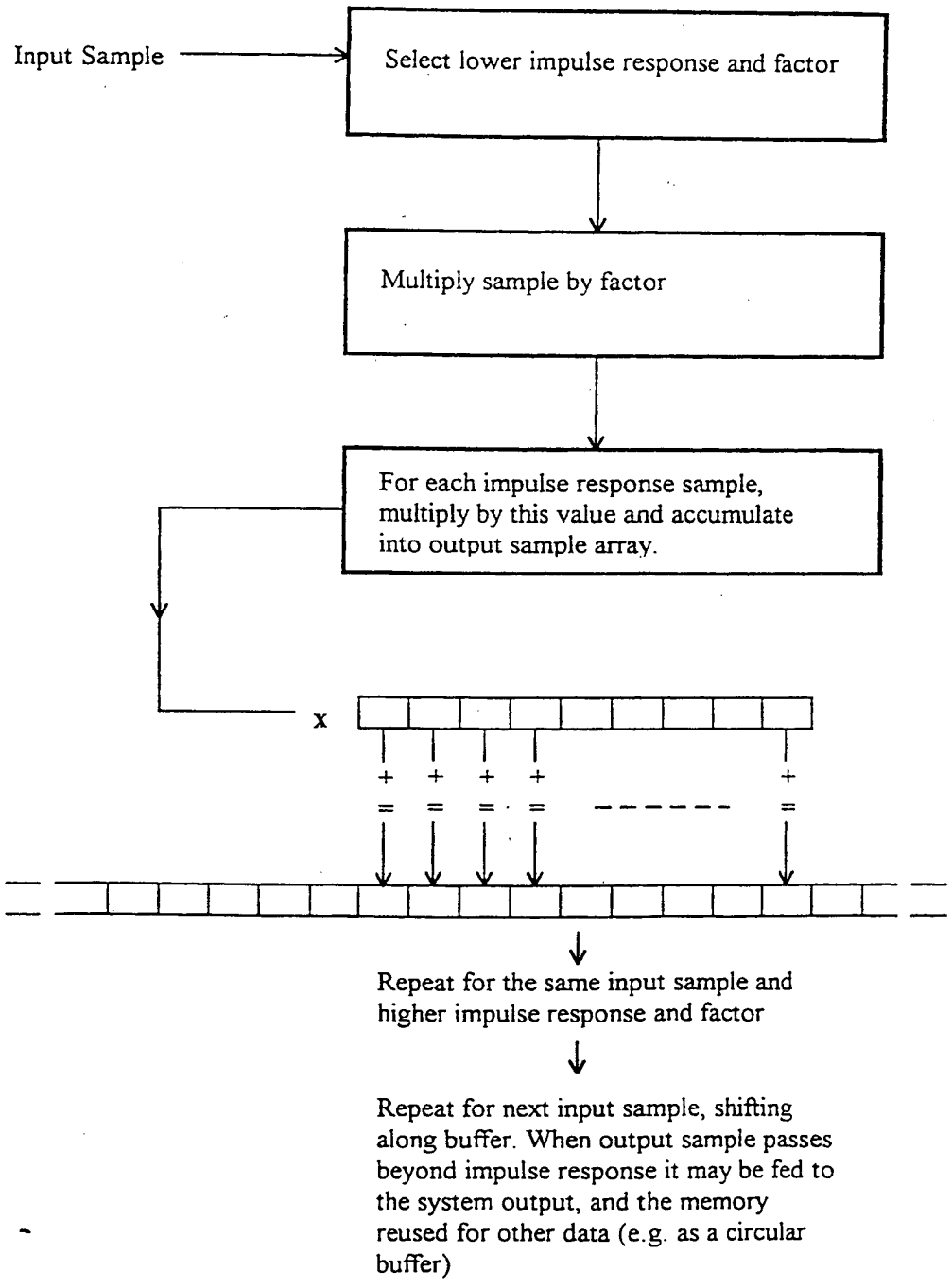

Input Sample
Select lower impulse response and factor
Multiply sample by factor
For each impulse response sample, multiply by this value and accumulate into output sample array.
x
Repeat for the same input sample and higher impulse response and factor
Repeat for next input sample, shifting along buffer. When output sample passes beyond impulse response it may be fed to the system output, and the memory reused for other data (e.g. as a circular buffer)

Fig 14

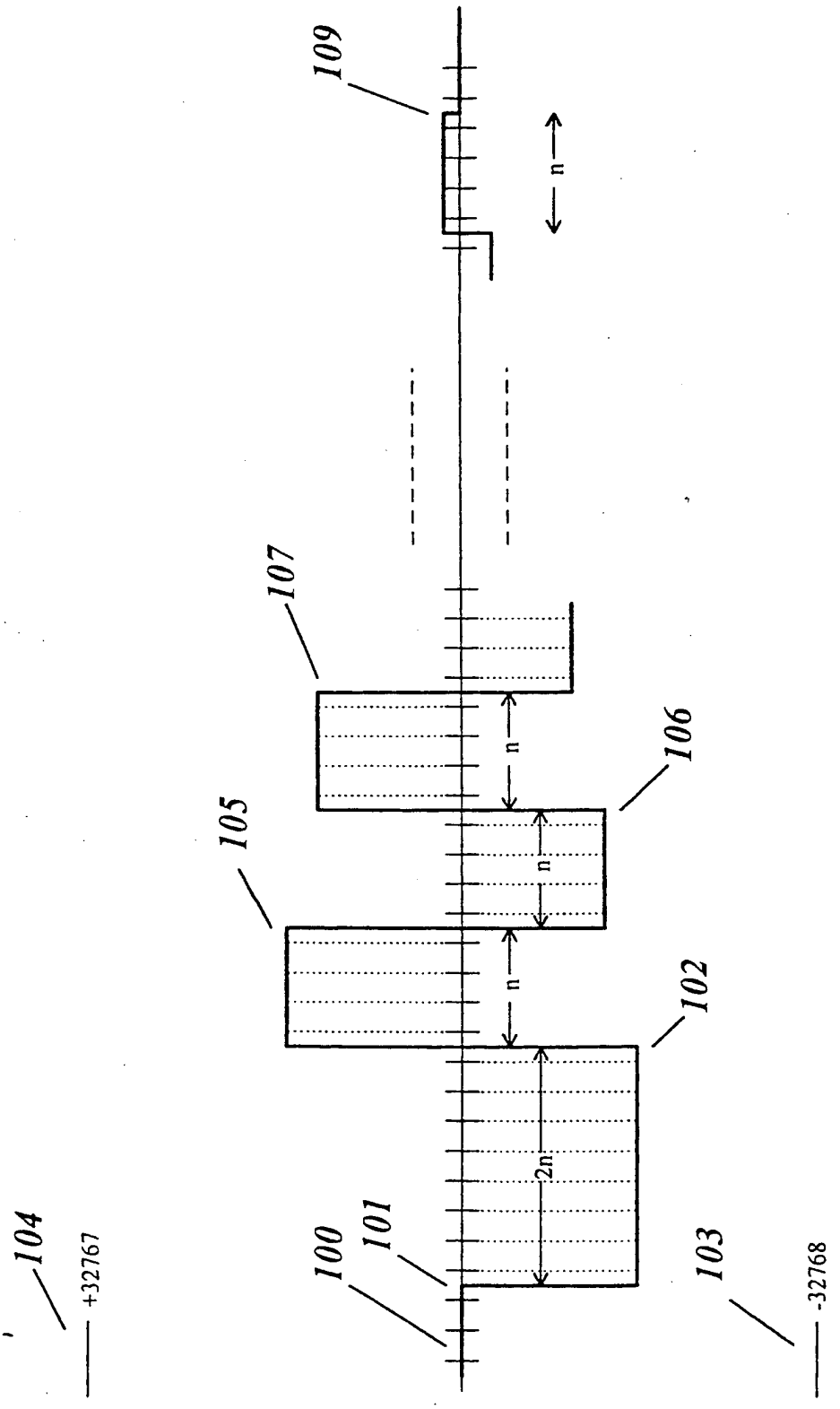


Fig 15

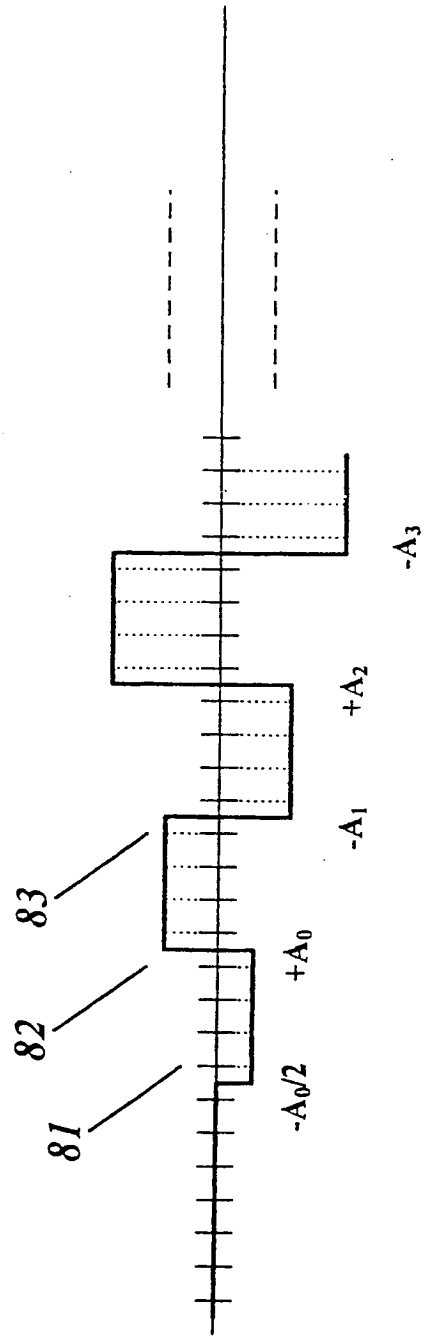


Fig 16

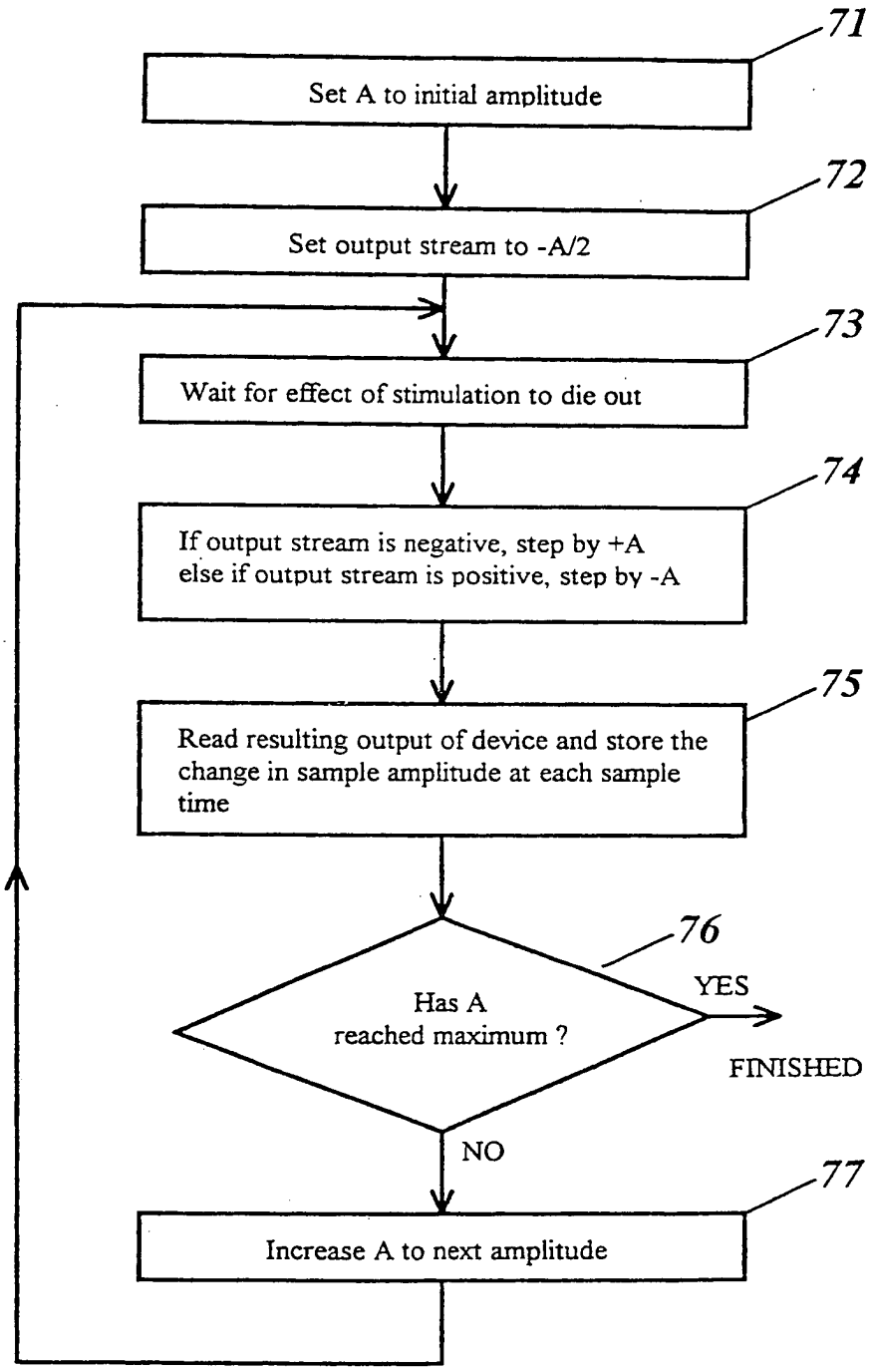

71
Set A to initial amplitude
72
Set output stream to -A/2
73
Wait for effect of stimulation to die out
74
If output stream is negative, step by +A
else if output stream is positive, step by -A
75
Read resulting output of device and store the change in sample amplitude at each sample time
76
Has A reached maximum ?
YES
FINISHED
NO
77
Increase A to next amplitude

Fig 17

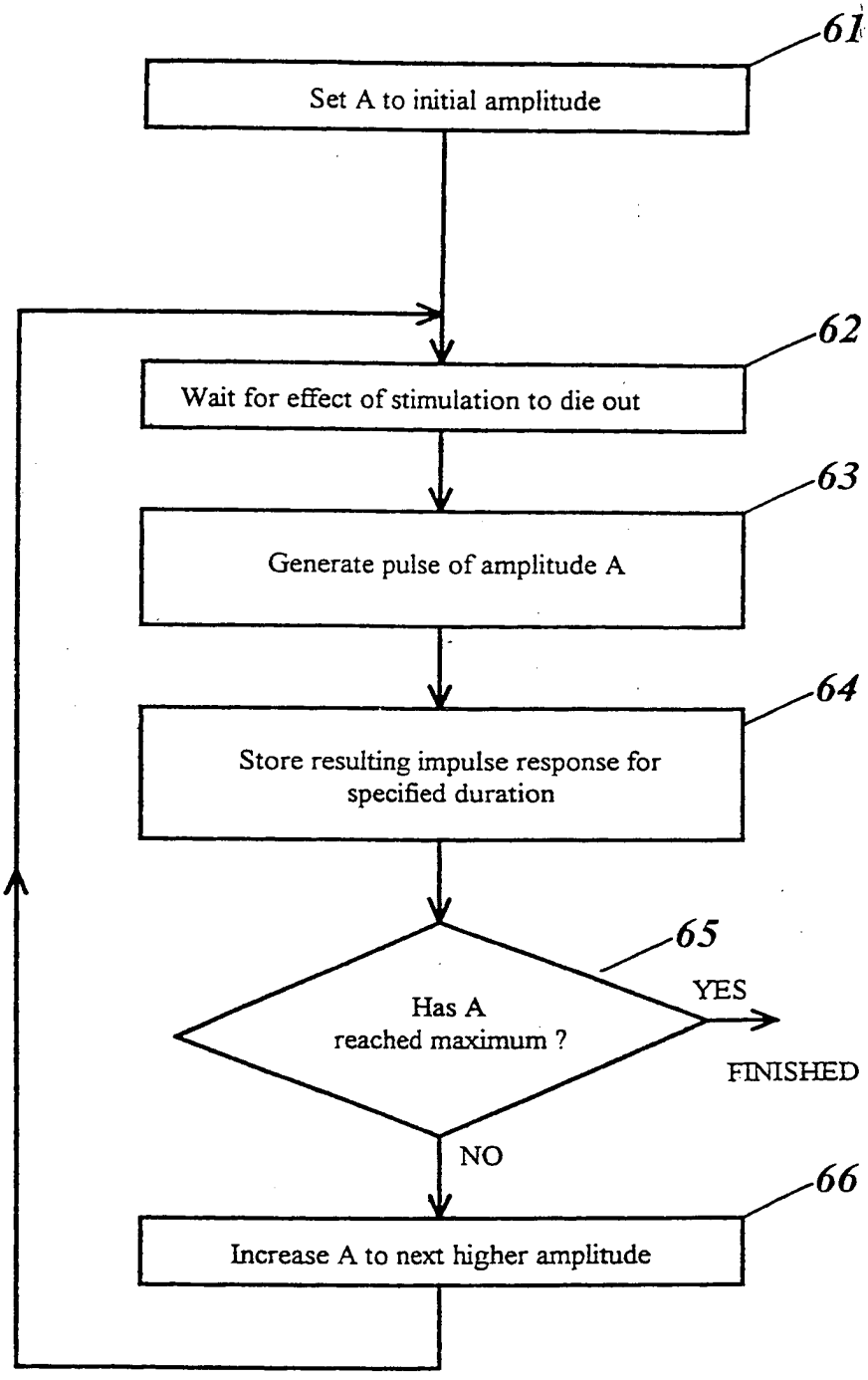
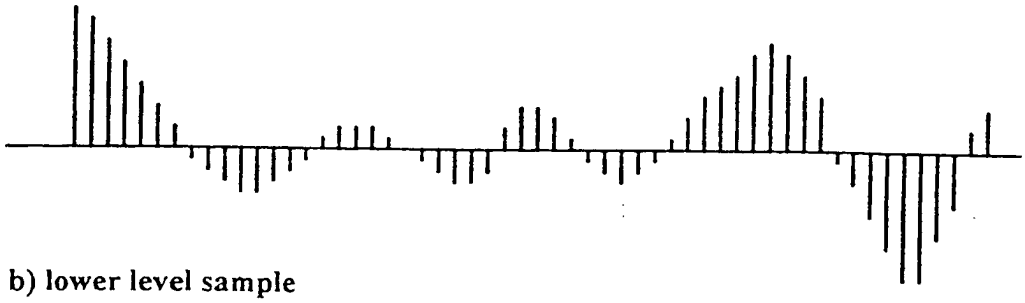
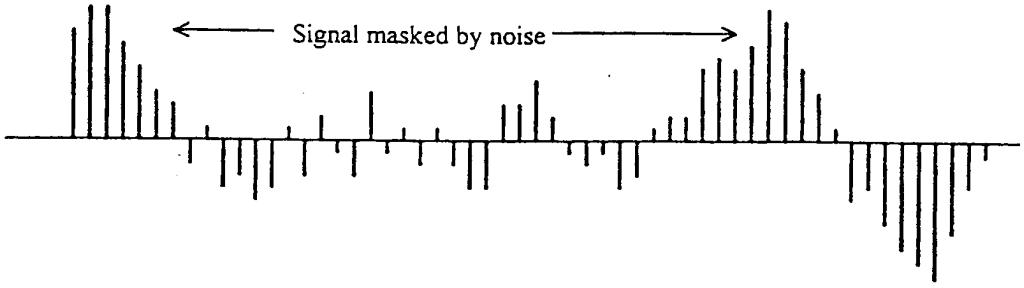

61
Set A to initial amplitude
62
Wait for effect of stimulation to die out
63
Generate pulse of amplitude A
64
Store resulting impulse response for specified duration
65
Has A reached maximum ?
YES
FINISHED
NO
66
Increase A to next higher amplitude

Fig 18

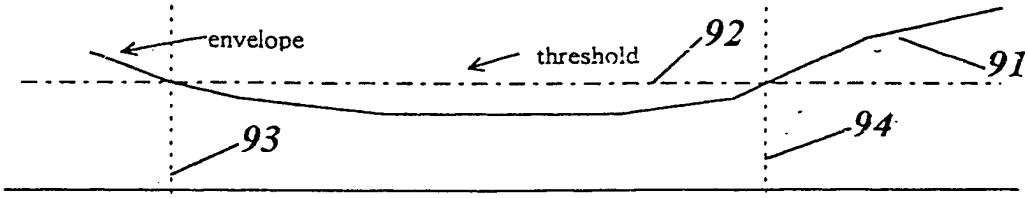
a) higher level sample



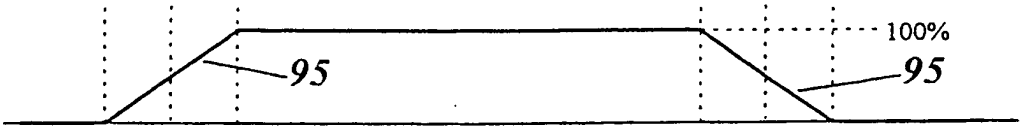
b) lower level sample



c) envelope of lower level sample relative to noise threshold



d) derived cross fade envelope



e) modified lower level impulse response

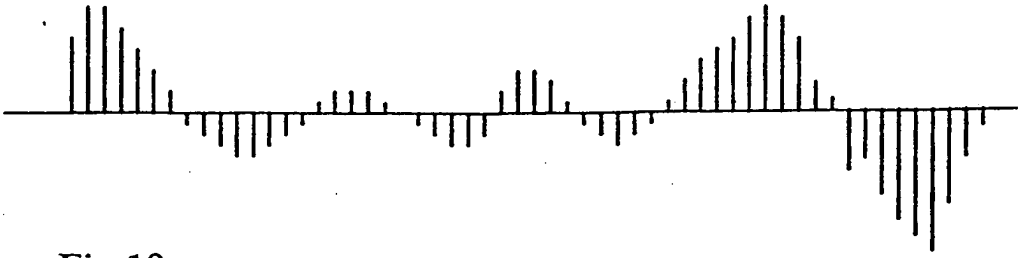


Fig 19

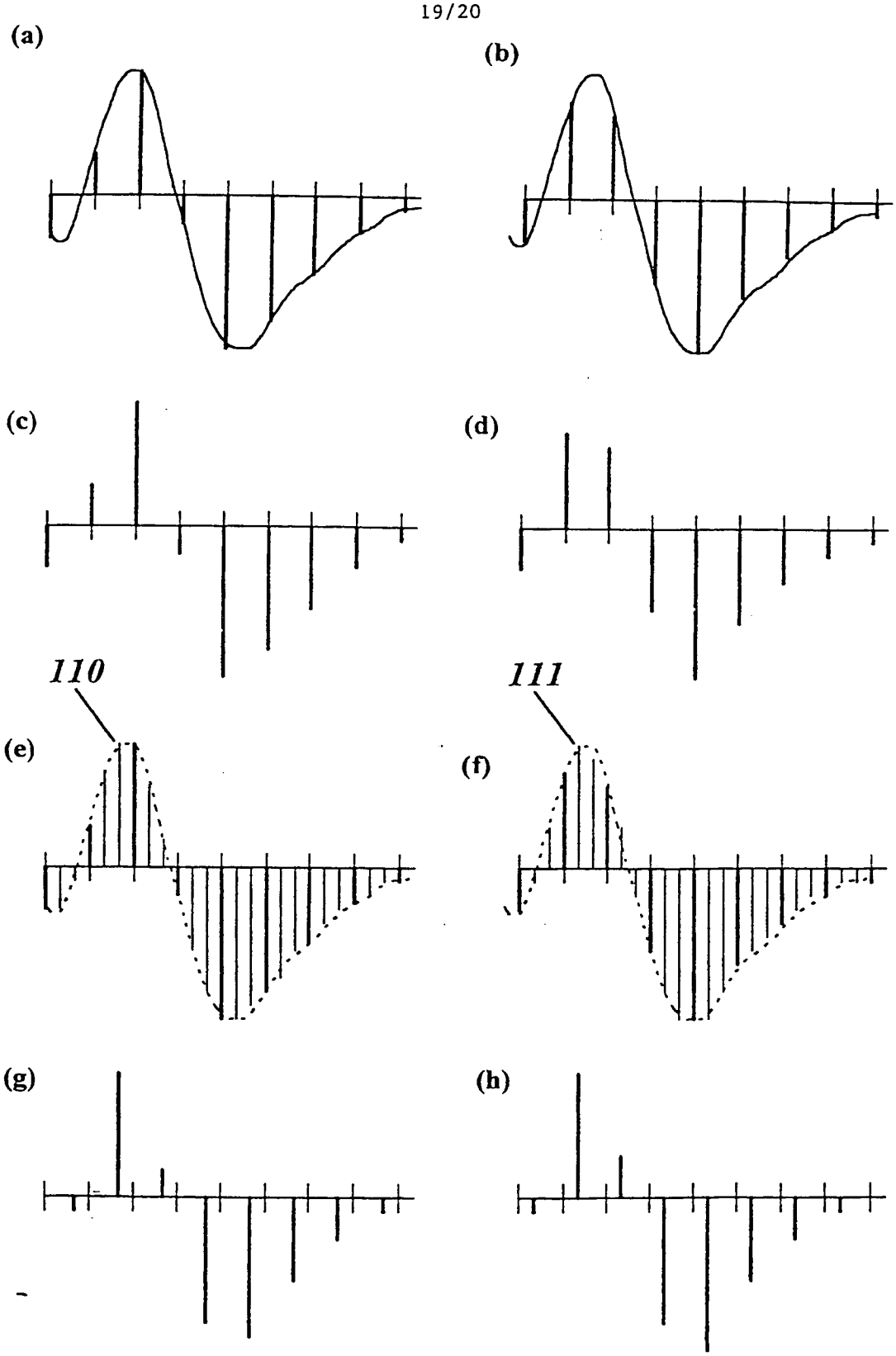


Fig 20

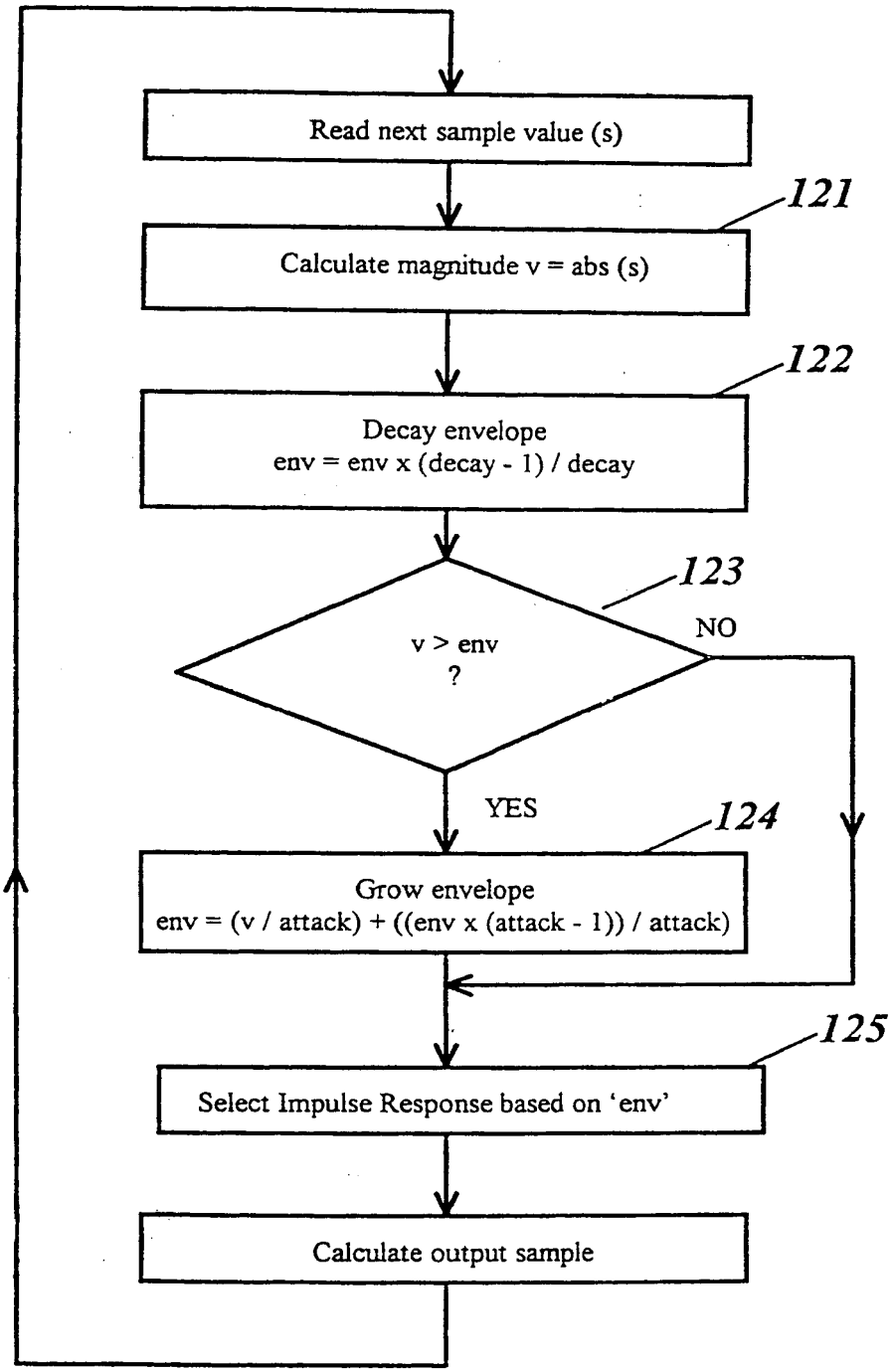

Read next sample value (s)
121
Calculate magnitude v = abs (s)
122
Decay envelope
env = env x (decay - 1) / decay
123
v > env
?
NO
YES
124
Grow envelope
env = (v / attack) + ((env x (attack - 1)) / attack)
125
Select Impulse Response based on 'env'
Calculate output sample

Fig 21